COPPER

FACT SHEET
April 2017

COPPER IN SOILS

Copper (Cu) is present in relatively small amounts in soils. Sandy soils that are low in organic matter have the lowest concentrations.

Elevated soil concentrations of copper are found in regions where copper rich ores are found, e.g. of silver, lead or zinc, and where copper fungicides have been routinely used.

Copper exists in various oxidation states, with the divalent ion (Cu^{2+}), the form taken up by plants, being the most common. Copper is tightly held on clay and organic colloids in the soil. Consequently, it is immobile in the soil and low concentrations are found in the soil solution. Copper is not easily lost by leaching.

Copper is most available for plant uptake in acid soils. Its availability declines as the soil pH increases above 7.0 due to stronger copper adsorption.

COPPER IN PLANTS

Copper is a trace element. It is taken up by plants in small quantities. It is also essential in animal nutrition.

Copper plays an important role in metabolic processes such as enzyme and chlorophyll formation, photosynthesis, respiration, and the metabolism of carbohydrate and some proteins.

Copper is not readily mobile in plants. Its movement appears to be strongly dependent on the copper status of the plant. In wheat plants well supplied with copper, movement occurs from leaves to the grain, but in deficient plants, copper is relatively immobile. An adequate supply of copper is essential at pollination in wheat. A deficiency may result in barren heads.

DEFICIENCY SYMPTOMS

As copper is relatively immobile in plants, deficiency symptoms first develop on the growing points and the leaves. Common symptoms are chlorosis or yellowing, first developing on the leaf edges. In cereals, white leaf tips and narrow, twisted leaves that fail to unroll may be evident at tillering. Ears may form but not fill. In extreme cases ear or panicle formation is absent. In sugarcane the symptoms are known as “Droopy-top”. “Die-back” occurs in tree crops.

Plant deficiencies of copper are most likely to occur in sandy soils and in alkaline soils.

In Australia, copper deficiency occurs less commonly in crops than does zinc, but more often than deficiencies of the other metallic trace elements, iron and manganese. Crops differ in their sensitivity to copper deficiency. Copper responsive crops include oats, wheat and lucerne, whilst potatoes and soybeans are less likely to respond.

TOXICITY SYMPTOMS

The inhibition of root and shoot growth is one of the first symptoms of copper toxicity, especially in bean, citrus and maize. Copper can displace metal ions (particularly iron) from their centres of activity within the plant, resulting in induced iron deficiency (chlorosis).

The range between deficiency and toxicity can be narrow, but varies. Some plant species are capable of accumulating copper to levels two to 50 times the normal value of copper in leaf dry matter without toxicity occurring. Legumes are particularly susceptible to high copper while grape vines are reported to be the most tolerant.

Pasture species may be unaffected by copper concentrations that are harmful to livestock.

COPPER IN ANIMALS

As in plants there is a narrow range between copper deficiency and toxicity in animals.

In Australia's eastern States, copper deficiency in grazing animals occurs most commonly occurs on sandy soils, particularly in areas of high rainfall. In South Australia, deficiency is more widespread, occurring on acidic and alkaline soils, and on sands, loams, clays and peats. It commonly occurs on calcareous sands.

Common symptoms of deficiency are retardation of growth, failure to fatten, coarsening and depigmentation of hair (pale, harsh dry coats), steely wool in sheep, nervous disorder (swayback) and muscular incoordination (ataxia), scouring (diarrhoea), abnormal bone formation (bones fracture easily) and anaemia (low haemoglobin in blood). Cattle are more susceptible to copper deficiency than sheep.

Copper poisoning is basically caused by an accumulation of copper in the liver of animals, which develops quickly into a toxaemic jaundice.

An imbalance in dietary copper, molybdenum and sulfur may induce nutritional problems in livestock, particularly if the animals are stressed, or are suffering liver damage. High concentrations of molybdenum and/or sulfur in forage can induce copper deficiency in grazing animals. Conversely, high dietary copper, low molybdenum and low sulfur may cause copper poisoning.

COPPER FERTILISERS

Copper can be applied to the soil or as foliar sprays. If high enough rates are applied, soil applications can remain effective for a number of years, while foliar applications need to be applied at least annually.

Copper will not need to be included in fertiliser programs where copper fungicides are routinely sprayed in horticultural crops.

Soil Application

As micronutrients (trace elements) such as copper are typically applied at low rates, they are usually applied with some form of carrier, e.g. with other fertilisers, and in solution with water.

Incitec Pivot manufactures a superphosphate concentrate containing 4% Cu, that is back-blended with ordinary superphosphate (SuPerfect), and Potash if required, to achieve the desired copper concentration, typically 0.5 - 1% Cu, in the end product, for use on pasture in southern Australia, e.g. Victoria.

Copper Granules, a copper oxysulfate product containing 25 % Cu, is used by Incitec Pivot in fertiliser blends where copper is required elsewhere in Australia, and in crops, e.g. sugarcane.

Copper products are also available that may be coated onto fertiliser granules.

Foliar Sprays

Bluestone or Copper sulfate pentahydrate (25 % Cu) may be used where copper is to be applied in solution (dissolved in water) to the soil or foliage. Bluestone is very corrosive and the advice of equipment manufacturers should be sought before use. Finely divided suspension grades of insoluble copper compounds may be used as an alternative, e.g. copper oxide and copper hydroxide, to reduce the risk of corrosion.

Chelates may also be used for soil and foliar application. Chelated trace elements are less subject to fixation in the soil than is sulfate, but are more costly.